Study of the electrical conduction through a two-dimensional InP-based photonic crystal

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The fundamental properties of photonic crystals (PhCs) have been intensively studied during recent years. PhCs are now being widely investigated for active and passive device applications. For some applications, tuning of the optical properties of PhCs is required [1]. One possible way is to change the refractive index of the PhC structure, for instance by temperature [2] or carrier plasma [3,4] effects. Electrical control provides versatility and possibility of easier integration of the devices. Therefore the investigation of possible carrier injection schemes through a PhC structure is crucial.

We present a study on current injection across two-dimensional PhCs fabricated in doped and undoped InP-based low-index-contrast vertical structure. The investigation was performed for different PhC lattice periods and air fill factors. As expected, we observe an increase of the resistivity of the PhC patterned area with (a) increasing the air fill factor and (b) reducing lattice period for a given air fill factor. For instance, a two-fold increase of resistance, with respect to an unpatterned reference sample, is measured for a PhC period of 450 nm and an air fill factor of around 30 %. Role of the etch-induced sidewall damage on the electrical properties of the PhCs and ways to optimize the injected current are discussed. As a first step towards electrical tuning, we discuss advantages and disadvantages of lateral injection schemes.

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